Claims

What is claimed is:

1. An interleave type decoding method, comprising steps of:

    receiving an interleaved block containing a number, *L*, of interleaved codewords, wherein the interleaving was done in such a manner that any *L* consecutive symbols consist of exactly one symbol from each of the *L* codewords, the interleaved codewords being made up of symbols;

    de-interleaving the interleaved block of symbols to obtain estimated codewords for the block of symbols, wherein errors may be present in the symbols;

    performing a first decoding of the estimated codewords by using a first error correction code;

    marking erasure positions in uncorrectable estimated codewords; and

    performing a second decoding of the estimated codewords by using the first error correction code, where the second decoding is at least partially based on the erasure positions marked from correctable estimated codewords.

2. The method of claim 1 wherein marking erasure positions further comprises marking erasure positions according to error positions extracted from correctable estimated codewords.

3. The method of claim 1 wherein performing a second decoding further comprises decoding only the uncorrectable estimated codewords according to the erasure positions marked from correctable estimated codewords.

4. The method of claim 1 further comprising determining a number of uncorrectable estimated codewords, wherein the determining function is done after the second decoding.

5. The method of claim 1 further comprising determining a number of uncorrectable estimated codewords, wherein the determining function is done after the first decoding.

6. The method of claim 1, wherein the single burst error correction capability is enhanced to $L \bullet (t_0+1)-1$ symbols, where L is the number of codewords in the de-interleaved block and t_0 is the random error correction capability of an individual codeword.

7. The method of claim 1, wherein an encoding procedure used to create the interleaved block comprises a transmission index that is assigned to each symbol according to the order in which the symbols will be transmitted through a communication channel.

8. The method of claim 7, wherein marking erasure positions further comprises:

sorting error positions, obtained in the first decoding, by the transmission index of erroneous symbols; and

examining the intervals between each consecutive error position.

9. The method of claim 8, wherein the examining the intervals further comprises:

determining an interval between consecutive error positions e_l and e_{l+1};

comparing the interval to a predefined threshold which is not greater than L;

marking as erasures the symbols that have a transmission index between e_l-L+1 and $e_{l+1}+L-1$, if the interval is less than the predefined threshold, where L represents the number of codewords in an interleave block.

10. The method of claim 9, wherein the predefined threshold is the same as L.

11. A decoder for use in a data communication system wherein random and burst errors may be present in the transmitted information code, comprising:

(a) an erasure marker for marking erasure positions in data sequences; and

(b) an error correction circuit for performing error correction on a de-interleaved block that was decoded from an interleaved block, where the interleaved block contained a number, L, of interleaved codewords, wherein the interleaving was done in such a manner that any L consecutive symbols consisted of exactly one symbol from each of the L codewords, operably coupled to the erasure marker, the error correction circuit being designed to perform a first decoding of the estimated codewords and subsequently perform a second decoding of the estimated codewords where the second decoding uses the same error correction circuit as the first decoding and is at least partially based on the erasure positions marked by the erasure marker.

12. The decoder of claim 11 wherein the erasure marker further comprises circuitry for marking erasure positions according to error positions extracted from correctable estimated codewords.

13. The decoder of claim 11 wherein the error correction circuitry further comprises circuitry for performing a second decoding only on the uncorrectable estimated codewords according to the erasure positions extracted from correctable estimated codewords.

14. The decoder of claim 11 wherein the error correction circuitry further comprises a counter for determining a number of uncorrectable estimated codewords.

15. The decoder of claim 11 wherein the error correction circuitry further comprises a counter for determining a number of uncorrectable estimated codewords after the second decoding.

16. The decoder of claim 11 wherein the error correction circuitry further comprises a counter for determining a number of uncorrectable estimated codewords after the first decoding.

17. The decoder of claim 11 wherein the single burst error correction capability is enhanced to $L \cdot (t_0+1)-1$ symbols, where L is the number of codewords in an interleaved block and t_0 is the random error correction capability of an individual codeword.

18. A disc drive comprising the decoder of claim 11 and further comprising:

at least one disc for storing data;

a transducer for reading and writing data from the disc;

a communication channel, operatively coupled to the transducer for transmitting data, the communication channel comprising the decoder.

19. A data communication system comprising:

(a) an encoder for producing an interleaved block containing a number, L, of interleaved codewords, wherein the interleaving was done in such a manner that any L consecutive symbols consist of exactly one symbol from each of the L codewords, the codewords containing symbols;

(b) a communication channel, operatively coupled to the encoder, that may introduce errors into the transmitted sequences;

(c) a decoder, operatively coupled to the communication channel, comprising:

(i) an erasure marker for marking erasure positions in estimated codewords; and

(ii) an error correction circuit for performing error correction on a de-interleaved block that was decoded from an interleaved block, where the interleaved block contained a number, L, of interleaved codewords, wherein the interleaving was done in such a manner that any L consecutive symbols consisted of exactly one symbol from each of the L codewords, operably coupled to the erasure marker, the error correction circuit being designed to perform a first decoding of the estimated codewords and subsequently perform a second decoding of the estimated codewords where the second decoding uses the same error correction circuit as the first decoding and is at least partially based on the erasure positions marked by the erasure marker.

20. The data communication system of claim 19 wherein the erasure marker further comprises circuitry for marking erasure positions according to error positions extracted from correctable estimated codewords.

21. The data communication system of claim 20 wherein the error correction circuitry further comprises circuitry for performing a second decoding only on the uncorrectable estimated codewords according to the erasure positions extracted from correctable estimated codewords.

22. The data communication system of claim 19 wherein the error correction circuitry further comprises a counter for determining a number of uncorrectable estimated codewords.

23. The data communication system of claim 19 wherein the encoder further comprises a transmission index that is assigned to each symbol according to the order in which the symbols are transmitted through the channel.

24. The data communication system of claim 19 implemented in a communication channel of a storage device such as a disc drive or CD-ROM.

25. A digital communication channel, comprising:
an interleave type encoder; and
means for decoding interleaved codewords using erasure markers.

26. A digital communication channel, comprising:

an interleave type encoder used for obtaining an interleaved block containing a number, L, of interleaved codewords, wherein the interleaving was done in such a manner that any L consecutive symbols consist of exactly one symbol from each of the L codewords; and

means for decoding estimated codewords at least twice while using the same error correction technique.

27. The digital communication channel of claim 26 where the means for decoding further comprises:

means for decoding uncorrectable estimated codewords according to erasure positions extracted from correctable estimated codewords.

28. The digital communication channel of claim 26 further comprising.

means for transmitting an index for an arranged sequence of symbols.

29. The digital communication channel of claim 26 further comprising:

means for marking symbols in estimated codewords as erasures.